include a personal computer (PC) or another computer, a digital camera, or a mobile device. Referring to FIG. **5**, the electronic device may include an image sensor **200**, a processor **300**, a memory **400**, a display device **500**, and a bus **600**. The image sensor **200** may capture external image information in response to the control of the processor **300**. The processor **300** may store the captured image information in the memory **400** through the bus **600**. The processor **300** may output the image information stored in the memory **400** to the display device **500**.

FIGS. **6** through **10** are diagrams of examples of a multimedia device to which an image sensor according to some embodiments of present inventive concepts is applied. The image sensor according to some embodiments of present inventive concepts may be applied to various multimedia devices having image capturing functions. For instance, the image sensor according to some embodiments of present inventive concepts may be applied to a mobile phone or smart phone **2000** as shown in FIG. **6** or applied to a tablet or a smart tablet **3000** as shown in FIG. **7**. Also, the image sensor according to some embodiments of present inventive concepts may be applied to a laptop computer **4000** as shown in FIG. **8** or applied to a television or smart television **5000** as shown in FIG. **9**. Furthermore, the image sensor according to some embodiments of present inventive concepts may be applied to a digital camera **6000** or a digital camcorder as shown in FIG. **10**.

A CMOS image sensor according to some embodiments of present inventive concepts can include a transfer gate electrode having rounded edges. Thus, occurrence of a leakage current due to GIDL caused by the crowding of an electric field between the transfer gate electrode and a floating diffusion region can be inhibited/reduced.

The above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments, which fall within the true spirit and scope. Thus, to the maximum extent allowed by law, the scope is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.

What is claimed is:

1. A complementary metal-oxide-semiconductor (CMOS) image sensor comprising:

a substrate including a pixel array and a peripheral circuit region;

a photodiode and a floating diffusion region in the pixel array of the substrate;

a transfer gate insulating layer and a transfer gate electrode on a portion of the substrate that is between the photodiode and the floating diffusion region; and

a peripheral gate insulating layer and a peripheral gate electrode on the peripheral circuit region,

wherein the transfer gate electrode includes a first edge that is rounded to have a first radius of curvature,

wherein the peripheral gate electrode includes a second edge that is rounded to have a second radius of curvature shorter than the first radius of curvature, and

wherein the transfer gate electrode further comprises a third edge that is rounded to have a third radius of curvature shorter than the first radius of curvature.

2. The CMOS image sensor of claim **1**, wherein a first portion of the transfer gate insulating layer adjacent the first edge of the transfer gate electrode is thicker than a second portion of the peripheral gate insulating layer adjacent the second edge of the peripheral gate electrode.

3. The CMOS image sensor of claim **1**, further comprising a pinned doped region on the photodiode in the substrate.

4. The CMOS image sensor of claim **3**, wherein the pinned doped region includes a first dopant of a first type that is different from a second type of a second dopant included in the photodiode.

5. The CMOS image sensor of claim **1**, wherein a lowest portion of a top surface of the floating diffusion region is at a lower level than a lowest portion of a top surface of the pinned doped region.

6. The CMOS image sensor of claim **1**, further comprising a reset gate electrode, a sensing gate electrode, and an access gate electrode on the pixel array.

7. The CMOS image sensor of claim **1**, further comprising source and drain regions in the substrate and aligned with the peripheral gate electrode.

8. The CMOS image sensor of claim **7**, wherein a lowest portion of a top surface of the floating diffusion region is at a lower level than top surfaces of the source and drain regions.

9. The CMOS image sensor of claim **1**,

wherein the first edge is aligned with the floating diffusion region, and

wherein the third edge is aligned with the photodiode.

10. The CMOS image sensor of claim **1**,

wherein the transfer gate electrode includes a first sidewall aligned with the floating diffusion region, and

wherein an upper edge of the first sidewall is rounded.

11. The CMOS image sensor of claim **10**,

wherein the transfer gate electrode includes a second sidewall aligned with the photodiode, and

wherein an upper edge of the second sidewall is rounded.

12. The CMOS image sensor of claim **11**, wherein the upper edge of the first sidewall has a longer radius of curvature than the upper edge of the second sidewall.

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